

---

## SUPPORT TO PRIVATE SECTOR TELECOMMUNICATIONS ACTIVITIES:

# Cooperative Research with Industry

### Outputs

- Interoperability measurements of Project 25 public safety radios.
- Measurements of ad hoc wireless network performance.
- Measurements of time-based transmitter and receiver performance.
- Measurements of X-band emissions from a newly developed radar.

The Federal Technology Transfer Act of 1986 (FTTA), as amended, allows Federal laboratories to enter into cooperative research agreements with private industry, universities, and other interested parties. The law was passed in order to provide Federal laboratories with clear legal authority to enter into these arrangements and thus encourage technology transfer to the private sector. Under this Act, a cooperative research and development agreement (CRADA) can be implemented that protects proprietary information, grants patent rights, and provides for user licenses to corporations, while allowing Government expertise and facilities to be applied to interests in the private sector.

ITS is a member of the Federal Laboratory Consortium for Technology Transfer (FLC), a network of over 700 Federal laboratories and the only government-wide forum for technology transfer. Organized in 1974 and formally chartered by the FTTA, the FLC provides the framework for developing technology transfer strategies and opportunities by promoting and facilitating technical cooperation among Federal laboratories, industry, academia, and State and local governments.

ITS participates in technology transfer and commercialization efforts by fostering cooperative telecommunications research with industry where benefits can directly facilitate U.S. competitiveness and market opportunities. ITS has participated for a number of years in CRADAs with private sector organizations to design, develop, test, and evaluate advanced telecommunication concepts. Research has been conducted under agreements with the following organizations:

- American Automobile Manufacturers Association
- ARINC
- AudioLogic, Inc.
- Bell Atlantic Mobile Systems
- Bell South Enterprises
- Coherent Technologies
- East Carolina University's Brody School of Medicine
- Eton Corporation
- FirstRF Corporation
- General Electric Company
- GTE Laboratories Inc.
- Hewlett-Packard Company (HP)
- Integrator Corporation
- Intel Corporation
- Johnson's Jobs
- Lehman Chambers
- Lucent Digital Radio
- Lucent Technologies
- Motorola/Freescale Inc.
- Netrix Corporation
- RF Metrics
- Savi Technologies
- Spectrum Mapping LLC
- Telesis Technology Laboratories
- University of Colorado
- University of Pennsylvania
- US WEST Advanced Technologies
- US WEST New Vector Group

Not only does the private sector partner benefit, but the Institute is able to undertake research in commercially important areas that it would not otherwise be able to do. Some of the active CRADAs in FY 2006 are described below.

**The University of Colorado** conducted measurements of the performance of ad hoc wireless networks with both ground-based and airborne terminals at ITS' Table Mountain Field Site. The Table Mountain Field Site is a National Radio Quiet Zone protected by Federal Regulation. Using IEEE 802.11 type equipment, routing protocols were tested and the performance of the ad hoc networks monitored. These measurements are contributing to the development of new wireless ad hoc network technologies.

Through a CRADA with **Eton Corporation** (and a Memorandum of Understanding (MOU) with the National Oceanic and Atmospheric Administration (NOAA), ITS has been testing radios manufactured by Eton Corporation and others for their ability to respond to the signals sent out by the NOAA All-Hazards Warning System.

**Johnson's Jobs**, a small Colorado technical contracting firm doing research for the Department of



*ITS and Johnson's Jobs staff at the Table Mountain Field Site, preparing to perform antenna measurements using the large turntable (photograph by J.W. Allen).*

Defense, entered into a CRADA with ITS in order to use the large turntable facility at Table Mountain for antenna testing. The turntable, a 10.4-meter diameter rotatable steel table mounted flush with the ground, is an unusual and valuable resource at the Table Mountain Field Site. As part of the CRADA, Johnson's Jobs upgraded the software in the test instrumentation housed in the laboratory space beneath the turntable.

Cooperative research with private industry has helped ITS accomplish its mission to support industry's productivity and competitiveness by providing insight into industry needs. This has led to adjustments in the focus and direction of other Institute programs to improve their effectiveness and value.

ITS is interested in assisting private industry in all areas of telecommunications. The pages of this technical progress report reveal many technological capabilities that may be of value to various private sector organizations. Such organizations are encouraged to contact ITS if they believe that ITS may

have technology useful to them. Because of the great commercial importance of many new and emerging telecommunication technologies, including third generation wireless (3G), wireless local area networks, digital broadcasting, and intelligent transportation systems, ITS will continue to vigorously pursue technology transfer to the private sector through CRADAs and thereby contribute to the rapid commercialization of these new technologies. ITS also plans to commit substantial laboratory resources to the development and standardization of new telecommunication technologies.

*For more information, contact:*

Brian D. Lane  
(303) 497-3484  
blane@its.blrdoc.gov  
or  
Dr. Margaret A. Luebs  
(303) 497-3572  
mluebs@its.blrdoc.gov

---

## SUPPORT TO PRIVATE SECTOR TELECOMMUNICATIONS ACTIVITIES:

# ITU-R Standards Activities

### Outputs

- Technical support to the U.S. Administration in Working Party 8B, the Radar Correspondence Group, and Joint Rapporteurs Group 1A-1C-8B, as well as Study Group 3 (see pp. 46-47).
- Measurements to determine the performance of prototype 5-GHz DFS devices in the presence of a 5-GHz air defense radar.
- Tests and measurements performed on effects of interference from communication system signals into an airborne weather radar and an airport ground-surveillance radar.
- Radar spectrum emission measurements performed on U.S. radars to support the U.S. Administration's position on tightening radar emission criteria for better spectrum efficiency.
- Presentation for the Tri-Service Radar Symposium in Boston on the effects of interference in radar receivers.

Success in worldwide telecommunication markets, as well as effective and compatible use of telecommunications technologies both domestically and abroad, is critical to the long-term economic health of the United States. To achieve these goals, the U.S. Administration actively participates in the most important world-wide telecommunications standards and regulatory body, the International Telecommunication Union — Radiocommunication Sector (ITU-R), to further its objectives with regard to all forms of wireless communications. ITS in turn provides important, ongoing technical support to the U.S. Administration in ITU-R Study Groups 3 and 8; Working Party 8B; the Radar Correspondence Group (RCG), and Joint Rapporteurs Group (JRG) 1A-1C-8B. Current areas

of interest include (but are not limited to): potential reallocation of radar spectrum; effects on radars of interference from communication systems; dynamic frequency selection technology proposed for 5-GHz spectrum sharing between communication systems and radars; development of radar emission spectrum measurement techniques; and development of more efficient radar spectrum emission criteria.

Proposals have been made by non-U.S. Administrations in ITU-R to introduce communication systems into bands that have heretofore been allocated for radars on a primary basis. One of these is dynamic frequency selection (DFS), in which communication systems automatically sense the presence of radar signals and avoid operations on locally occupied radar frequencies. Since the U.S. Administration has made an enormous investment in the development and deployment of both military and civilian radars, it is essential that new systems proposed for spectrum sharing with radars be shown to be electromagnetically compatible with existing and future radars. To this end, ITS engineers in FY 2006 tested the new technology, DFS, for the U.S. Administration.

The tests were conducted jointly between ITS, the NTIA Office of Spectrum Management (OSM), other Federal Agencies, and industry. Several 5-GHz DFS RLAN prototypes were tested at the White Sands Missile Range to determine the extent to



*Figure 1. A 2006 meeting of ITU-R Working Party 8B (the maritime and radar group) in Geneva (photograph by F.H. Sanders).*

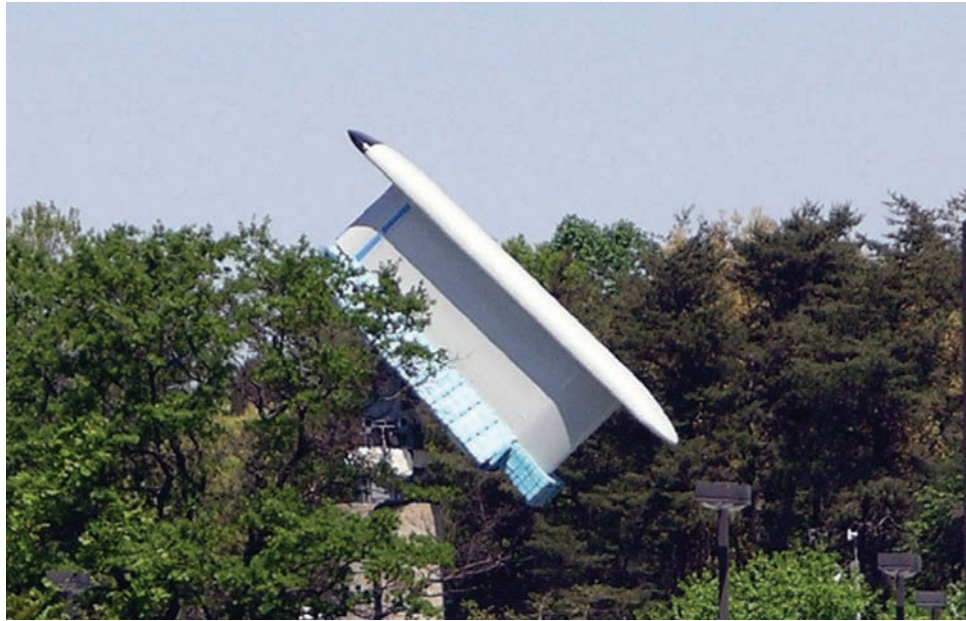


which they could successfully sense the presence of signals from an air defense radar; those results were used by the U.S. Administration at ITU-R meetings in FY 2006.

ITS and OSM have worked closely together for the last several years to learn more about the effects of interference in radar receivers. In FY 2006 they published a landmark NTIA Report on the results of the last five years of work in this area. Additional interference tests and measurements were performed by ITS and OSM engineers on an airborne weather radar and an airport ground-control radar. Interference signals were injected into the radar receivers while targets were observed. At a variety of interference levels, the effects on target detection were observed. The effects of swept-frequency pulses generated by some other radars, called chirped pulses, were also studied. The radar receivers were found to be highly sensitive and susceptible to interference from communication signals at low levels, well below the noise floor of the radar. However, no interference effects were noted in the presence of chirped pulses and other types of radar pulses; these results indicated that all of the radar types that have been studied to date have been highly compatible with other radar systems but not so compatible with communication signals. The test results have been used for U.S. Contributions in WP-8B, the Tri-Service Radar Symposium, and NTIA Reports and Technical Memoranda.

Additional work in the ITU-R has been devoted to chairmanship of the Radar Correspondence Group by an ITS engineer, as well as ongoing support and written Contributions for JRG 1A-1C-8B on the topic of future development of radar spectrum emission criteria.

Finally, in FY 2006 ITS organized and hosted an important meeting of the Joint Rapporteurs Group 1A-1C-8B in Boulder, Colorado, on topics related to improvement of radar emission spectrum mask limits.



*Figure 2. A radar during emission measurements performed in support of the U.S. Administration position in the ITU-R (photograph by F.H. Sanders).*

#### Recent Publications

F.H. Sanders and B.J. Ramsey, "Phased array antenna pattern variation with frequency and implications for radar spectrum measurements," NTIA Report TR-06-436, Dec. 2005.

F. Sanders, J. Wepman, and S. Engelking, "Development of performance testing methods for dynamic frequency selection (DFS) 5-GHz wireless access systems (WAS)," in "Proceedings of the International Symposium on Advanced Radio Technologies, March 7-9, 2006," P. Raush and K. Novik, NTIA Special Publication SP-06-438, Mar. 2006.

F.H. Sanders, J.R. Hoffman, and Y. Lo, "Resolving interference from an airport surveillance radar to a weather radar," NTIA Technical Memorandum TM-06-439, Apr. 2006.

F.H. Sanders, R.L. Sole, B.L. Bedford, D. Franc, and T. Pawlowitz "Effects of interference on radar receivers, NTIA Report TR-06-444, Sep. 2006.

*For more information, contact:*

Frank H. Sanders

(303) 497-7600

e-mail fsanders@its.bldrdoc.gov

---

## SUPPORT TO PRIVATE SECTOR TELECOMMUNICATIONS ACTIVITIES:

# ITU-T & Related U.S. Standards Development

### Outputs

- Leadership of ITU-T and related U.S. telecommunications standards committees.
- Technical contributions presenting U.S. standards proposals and ITS research results.
- Proposed ITU-T Recommendations and associated U.S. industry standards.

The Institute has a long history of leadership, technical contributions, and advocacy of U.S. Government and industry proposals in the International Telecommunication Union's Telecommunication Standardization Sector (ITU-T) and related U.S. standards organizations. ITU-T is a specialized agency of the United Nations, responsible for developing the international standards (Recommendations) providers use to plan, interconnect, and operate public telecommunication networks and services worldwide. ITU-T Recommendations strongly impact both the evolution of U.S. telecommunication infrastructures and the competitiveness of U.S. telecommunication products in international trade.

The Institute's long-term goal in ITU-T (and related national standards work) is to motivate the standardization of user-oriented, technology-independent measures of telecommunication service quality, and to relate those measures with the technology-specific performance metrics and mechanisms providers use to provision and operate networks. This work promotes fair competition and technology innovation in the telecommunications industry, facilitates interworking among independently-operated networks and dissimilar technologies, and helps users define their telecommunication needs and select products and services that meet them.

In FY 2006, the Institute provided leadership in two key ITU-T groups: Study Group (SG) 13 and SG 9's Working Group on Quality Assessment. Institute staff also provided leadership in the ANSI-accredited Performance, Reliability, and Quality of Service Committee (PRQC). SG 13 is developing international standards for Internet Protocol (IP) based Next Generation Networks (NGNs) that

will offer integrated voice, video, data, and multimedia services — and innovative new services like IP television — with assured quality levels. An ITS staff member serves as Vice Chair of ITU-T SG 13 and chairs SG 13's Working Party (WP) 4, which develops NGN standards on Quality of Service (QoS) and Operations, Administration, and Maintenance (OAM). An ITS staff member chairs SG 9's Working Group on Quality Assessment, which defines quality objectives for integrated broadband cable networks and television and sound transmission. In that group, ITS chairs Question 14/9, "Objective and Subjective Methods for Evaluating Audiovisual Quality in Multimedia Services." ITS also leads and contributes to the ITU-affiliated Video Quality Experts Group (VQEG), which works with SG 9, SG 12, and ITU-R WP 6Q (Broadcasting Services — Performance Assessment and Quality Control) to develop objective, computer implementable, perception-based video quality metrics (VQMs) that emulate the human visual system. ITS also leads the Joint Rapporteur Group on Multimedia Quality Assessment (JRG-MMQA), a cross-cutting ITU-T standards body that unites the video quality expertise of SG 9 with the audio quality expertise of SG 12 in an effort to develop objective, perception-based metrics for combined audio and video signals in mobile and PC environments. ATIS PRQC develops national standards and contributes strongly to ITU-T standardization in all of these technology areas. ITS leads PRQC's QoS and Security Task Forces.

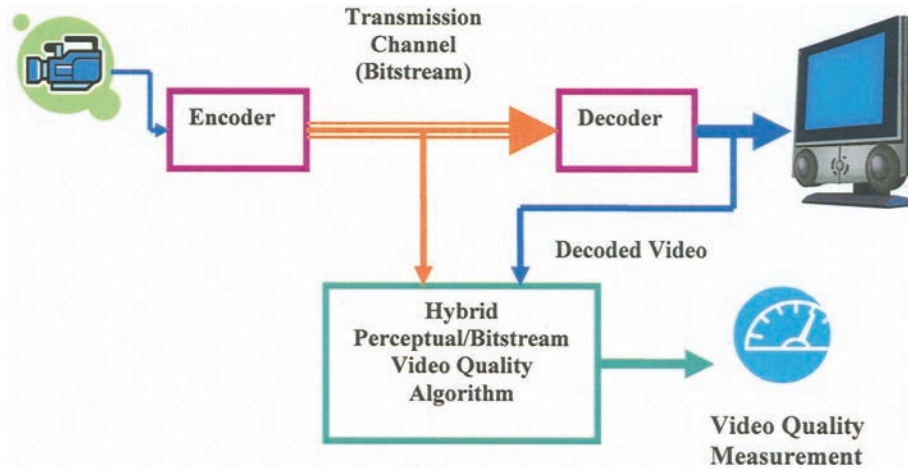
In FY 2006, SG 13 processed over 1000 technical contributions and completed 14 new ITU-T Recommendations, collectively defining the key requirements and architectures for NGN. WP 4/13 developed four of these new Recommendations: Y.2111, which defines the architecture for the NGN Resource and Admission Control Function (RACF); Y.1731, which defines OAM fault management and performance monitoring functions for carrier class Ethernet networks; Y.2171, which defines admission control priority levels for Emergency Telecommunications Service (ETS) in NGNs; and Y.1714, which defines a management and OAM framework for multi-protocol label switching (MPLS) networks. Y.2111 is central to ITU's NGN concept and is considered by many to be the most

important NGN standard published to date. Y.1731 will enable carriers to deploy Ethernet technologies in metropolitan and wide-area networks.

PRQC's FY 2006 work produced a new American National Standard that specifies an algorithm that can assess transmitted voice quality using only observations of the output voice signal. This "single-ended" assessment technique will be valuable to providers in situations where non-intrusive, in-service quality measurements are required. ITS performed an independent technical evaluation of the proposed algorithm using its Audio Quality Measurement System. In other standards leadership, ITS developed a major section of the ATIS Board of Directors' NGN Focus Group (NGN-FG) report, "ATIS Next Generation Network (NGN) Framework, Part III: Standards Gap Analysis." This work motivated four new standards project proposals in PRQC.

ITS has co-chaired the ITU Video Quality Experts Group since its formation in 1997. VQEG enables video experts from many countries to collaborate in developing and evaluating video quality metrics (VQMs), and its results strongly impact the standardization of VQMs in both ITU-T and ITU-R. The group works primarily via an e-mail reflector, publicly accessible at <http://www.VQEG.org>. During FY 2006 the number of participants subscribed to this reflector grew to 519. ITS chaired two physical VQEG meetings in FY 2006. ITS also contributed to VQEG's Reduced Reference-No Reference (RR-NR) TV, HDTV, and Multimedia video test plans and provided key video source material during FY 2006. ITS is spearheading new ITU-T work on multimedia quality assessment through its leadership in VQEG and the JRG-MMQA. The latter group met three times during FY 2006.

In both VQEG and ITU-T Study Group 9, work has begun on a new approach to objective video quality assessment (illustrated in the figure above). This approach, called the hybrid perceptual/bitstream



*Diagram of the hybrid perceptual/bitstream video quality approach.*

method, combines information obtained from analysis of the transmission channel bitstream (e.g., codec type and parameters, bit rate, error rates, etc.) with perceptual information obtained from analysis of the decoded video frames (e.g., edge detail, frame rate, amount of jerky motion, tiling, errored blocks). This approach promises to provide monitoring capabilities that will be both more accurate and more easily implemented than currently available methods. Several organizations are developing such composite objective video quality assessment methods. This methodology is well suited to the monitoring needs of cable television and IPTV providers, and can be used to monitor the quality of video to cell phones, PDAs, and PCs. VQEG is developing a test plan to validate these methods, and Study Group 9 plans to standardize the specific systems that prove to be most useful.

During FY 2006, ITS staff members also organized and chaired technical sessions at two ITU-T sponsored workshops: a SG 13/SG 15 Joint Workshop on NGN and its Transport Networks and a SG 12 Workshop on QoS. The two workshops together attracted over 500 participants. Results are summarized at <http://www.itu.int/ITU-T/worksem/ngn/200604/program.html> and <http://www.itu.int/ITU-T/worksem/qos/200606/programme.html>.

*For more information, contact:*  
 Neal B. Seitz  
 (303) 497-3106  
 e-mail [nseitz@its.blrdoc.gov](mailto:nseitz@its.blrdoc.gov)